

Remarks:

Reconsideration of the application is requested.

Claims 1-21 remain in the application. Claims 1, 10-12, 14, and 19-20 have been amended. Claims 1-7 and 21 have been withdrawn from consideration.

Between the last paragraph on page 2 and the first paragraph on page 3 of the above-identified Office action, the Examiner requires affirmation of the election of claims 8-20, directed to a method. The election of claims 8-20 is hereby affirmed.

In the second paragraph on page 3 of the Office action, Figs. 6-12 of the drawings were objected to as not containing a legend such as --Prior Art--. Figs. 6-12 of the drawings were corrected as suggested by the Examiner. New "final" drawings of Figs. 6-12 are enclosed.

Between the last paragraph on page 3 and the first paragraph on page 4 of the Office action, claims 8, 10, 11, and 14 have been rejected as being indefinite under 35 U.S.C. § 112, second paragraph. The Examiner's comments were noted and claim 8 was amended as to recite "forming a doped region in said buried contact region by introducing a dopant into the substrate in a region underneath a surface of the substrate

...", thereby, clearly reciting that the "doped region" is formed by introducing the recited "dopant".

In the last paragraph on page 4 of the Office action, claims 9, 12, 13, and 15-20 have been rejected for being dependent on previously rejected claims under 35 U.S.C. § 112, second paragraph.

It is accordingly believed that the claims meet the requirements of 35 U.S.C. § 112, first and second paragraphs. Should the Examiner find any further objectionable items, Counsel would appreciate a telephone call during which the matter may be resolved. The above-noted changes to the claims are provided solely for the purpose of satisfying the requirements of 35 U.S.C. § 112. The changes are neither provided for overcoming the prior art nor do they narrow the scope of the claim for any reason related to the statutory requirements for a patent.

In the second paragraph on page 5 of the Office action, claims 8, 9, 12, 13, and 15-18 have been rejected as being anticipated by *Applicant's Admitted Prior Art* under 35 U.S.C. § 102.

In the second paragraph on page 7 of the Office action, claim 14 has been rejected as being obvious over *Applicant's Admitted Prior Art* under 35 U.S.C. § 103.

In the last paragraph on page 7 of the Office action, claims 19-20 have been rejected as being obvious over *Applicant's Admitted Prior Art* under 35 U.S.C. § 103.

In the second paragraph on page 8 of the Office action, claims 8-13 and 15-20 have been rejected as being obvious over *Applicant's Admitted Prior Art* in view of *Canale et al.* (US Patent No. 6,040,213) or *Hoepfner* (US Patent No. 6,008,103) under 35 U.S.C. § 103.

As will be explained below, it is believed that the claims were patentable over the cited art in their original form and the claims have, therefore, not been amended to overcome the references. However, claim 8 was amended in order to overcome a § 112 rejection and one feature in claim 8 is now more clearly defined.

Before discussing the prior art in detail, it is believed that a brief review of the invention as claimed, would be helpful.

Claim 8 as amended calls for, inter alia:

forming a doped region in said buried contact region by introducing a dopant into the substrate in a region underneath a surface of the substrate by at least one process selected from the group consisting of implantation, plasma doping, and vapor phase deposition.

Applicant's Admitted Prior Art is described on page 23, lines 12-15, of the instant application wherein it is stated that "[i]n a subsequent heat-treatment step, dopants from the doped polysilicon 161 **diffuse** upward and outward through the strap 162 **in order to form** the buried contact [region] 250."

(emphasis added) Hence, *Applicant's Admitted Prior Art* discloses a buried doped contact region produced by diffusion and **not** a buried contact region where dopants have been introduced by at least one of an implantation doping, a plasma doping, and a vapor phase deposition.

Canale et al. state in col. 4, lines 63-65, "conductive elements **diffuse** into diffusible material 42 **to form** a layer of conductive material, which comprises **the buried conductive strap**." (emphasis added). Similarly, *Hoepfner* states in col. 8, lines 45-48, that "[t]he dopant drive in process causes the dopant doped earlier via the plasma-enhanced doping process to **diffuse** further into the substrate **to form** the conductive region of the **buried plate**" (emphasis added).

The underlying inventive concept of the invention of the instant application is to have a buried contact region where dopants have been introduced by at least one of an implantation doping, a plasma doping, and a vapor phase deposition. The introduction of dopants into a region by implantation doping, plasma doping, and vapor phase deposition instead of out-diffusion leads to a completely different structure and geometry of a doped region. The doped region can be realized with a much smaller size and its borders can be controlled accurately so that short channel effects and punch-through are avoidable. This has the advantage that the size of the trench cell and the junction depth can be reduced (see discussion on page 49, third paragraph, of the instant application). *Applicant's Admitted Prior Art* in view of *Canale et al.* or *Hoepfner* neither suggest nor do they contain the relevant teaching suggesting such a buried contact region. Therefore, the invention as recited in claim 8 of the instant application is believed not to be obvious over *Applicant's Admitted Prior Art* in view of *Canale et al.* or *Hoepfner*.

Therefore, the invention as recited in claim 8 of the instant application is believed not to be anticipated by *Applicant's Admitted Prior Art* or to be obvious over *Applicant's Admitted Prior Art* in view of *Canale et al.* or *Hoepfner*. Claim 8 is, therefore, believed to be patentable over the art and since


claims 9-20 are ultimately dependent on claim 1, they are believed to be patentable as well.

In view of the foregoing, reconsideration and allowance of claims 8-20 are solicited.

Petition for extension is herewith made. The extension fee for response within a period of two months pursuant to Section 1.136(a) in the amount of \$ 400.00 in accordance with Section 1.17 is enclosed herewith.

Please charge any other fees which might be due with respect to Sections 1.16 and 1.17 to the Deposit Account of Lerner and Greenberg, P.A., No. 12-1099.

Respectfully submitted,



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For Applicants

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October 23, 2001

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Applic. No. : 09/363,277

Version with markings to show changes made:

Claim 8 (amended). A method for producing a trench capacitor, which comprises the following steps:

providing a substrate;

forming a trench with a lower region and an upper region in the substrate;

filling the lower region of the trench with a first filling material;

forming an insulation collar in the upper region of the trench;

removing the first filling material from the lower region of the trench;

lining the lower region of the trench and an inner side of the insulation collar with a dielectric layer as a capacitor dielectric;

filling the trench with a conductive second filling material as a capacitor plate;

providing a buried contact region for said capacitor plate underneath a surface of said substrate; and

forming a doped region in said buried contact region by
introducing a dopant into the substrate in a region underneath
a surface of the substrate [in a vicinity of the buried
contact] by at least one process selected from the group
consisting of implantation, plasma doping, and vapor phase
deposition.

Claim 10 (amended). The method according to claim 8, wherein
the step of introducing a dopant includes one of an oblique
doping and an isotropic doping through an uncovered interface
of the buried contact region.

Claim 11 (amended). The method according to claim 8, wherein
the step of introducing a dopant includes one of an oblique
doping and an isotropic doping through a screen oxide on an
interface of the buried contact region.

Claim 12 (amended). The method according to claim 8, which
comprises forming a tunnel layer on an interface of the buried
contact region.

Claim 14 (amended). The method according to claim 8, wherein
the step of introducing a dopant includes vapor phase doping
through an exposed interface of the buried contact region with
one of AsH_3 and PH_3 at 1100°C , 1 min, and 760 Torr.

Claim 16 (amended). The method according to claim 8, which comprises:

filling the trench with a fourth filling material being selectively removable with respect to the substrate, the insulation collar, and the dielectric layer, after the steps of forming the insulation collar and lining the lower region of the trench and the inner side of the insulation collar with a dielectric layer;

recessing the fourth filling material, the insulation collar, and the dielectric layer for defining an interface between the buried contact region and the substrate;

removing the fourth filling material; and

filling the trench with the conductive second filling material.

Claim 19 (amended). The method according to claim 12, which comprises loading the substrate in a process chamber and performing the steps of providing the buried contact region and forming the tunnel layer in a single process sequence without removing the substrate from the process chamber.

Claim 20 (amended). The method according to claim 18, which comprises loading the substrate in a process chamber and

performing the steps of providing the buried contact region, forming the tunnel layer, and forming the buried strap in a single process sequence without removing the substrate from the process chamber.

PRIOR ART

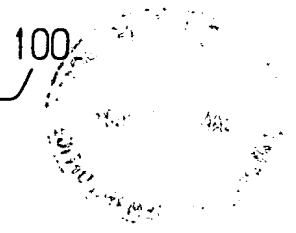


FIG 7 a PRIOR ART

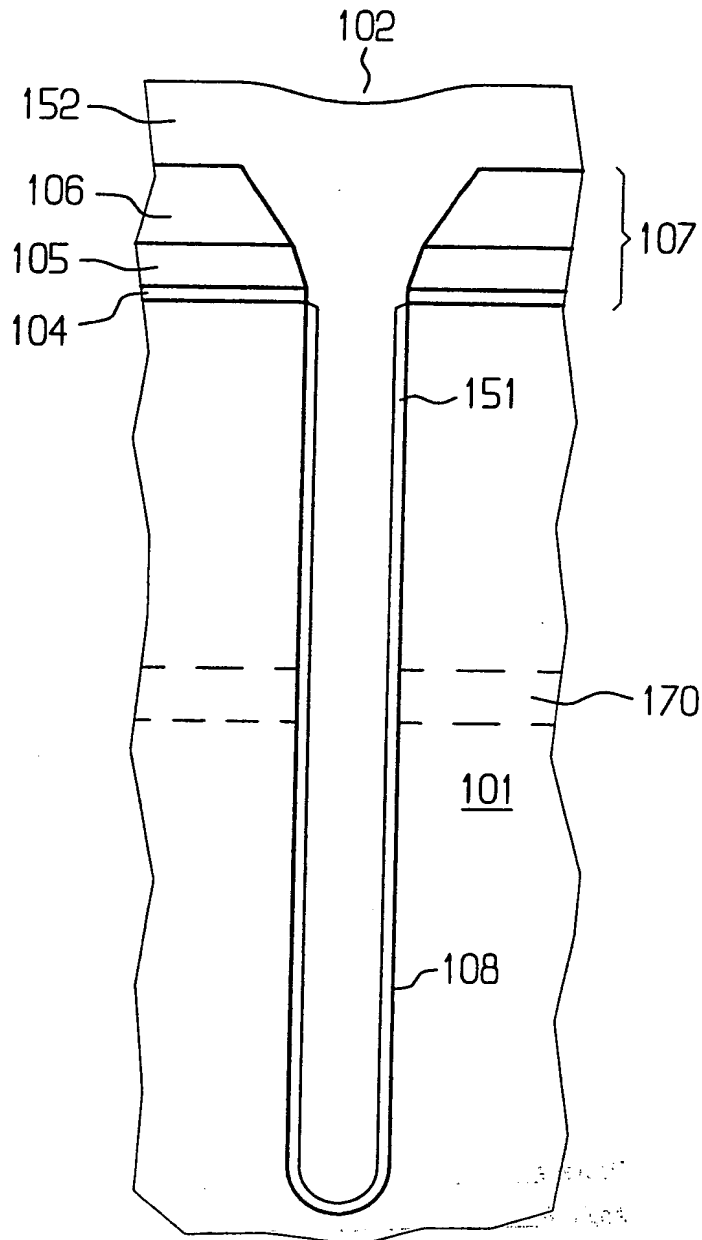


FIG 7b PRIOR ART

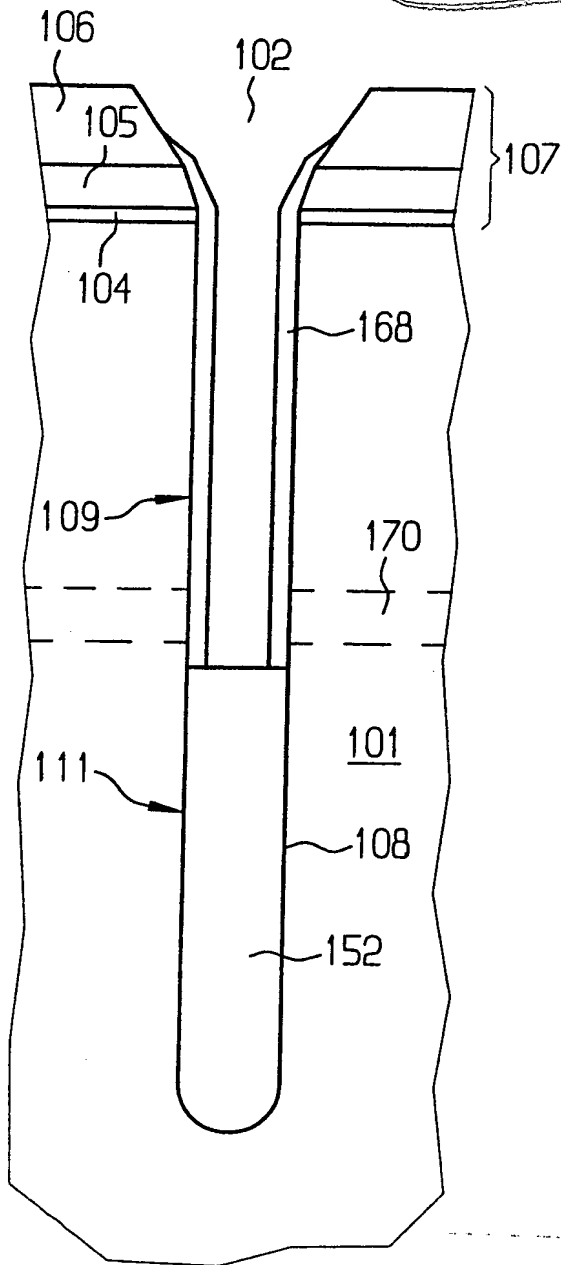


FIG 7c PRIOR ART

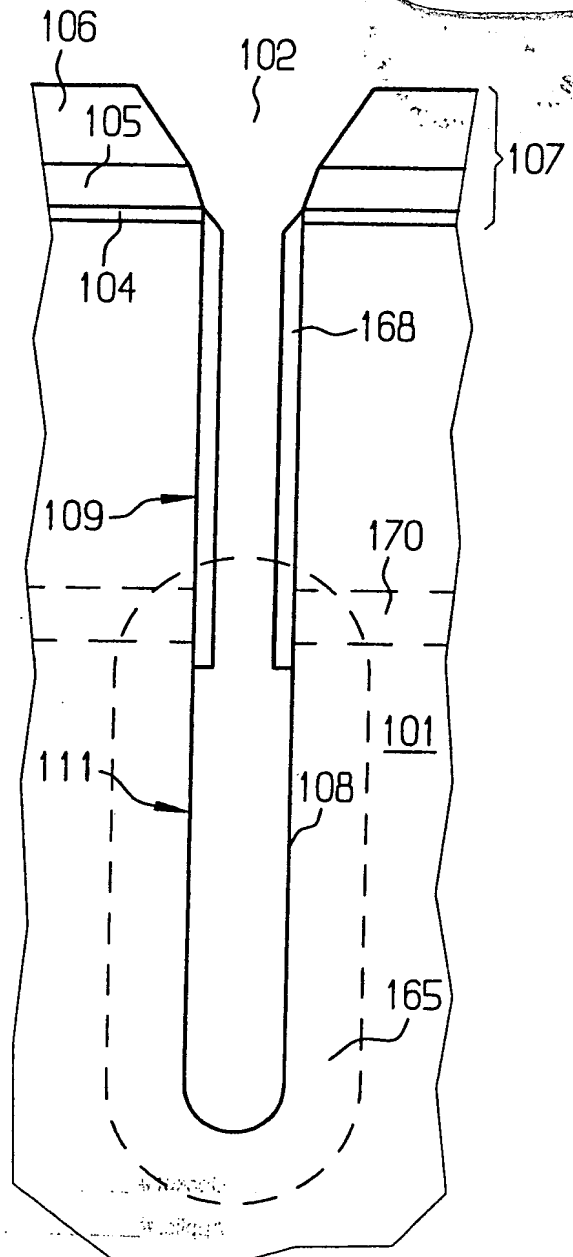


FIG. 7b and FIG. 7c are prior art diagrams showing cross-sectional views of a device. FIG. 7b shows a device with a central vertical channel 109 and a side channel 168. FIG. 7c shows a device with a central vertical channel 109 and a side channel 168. The devices are shown in cross-section, with various layers and components labeled. The devices are shown in a cross-sectional view, with various layers and components labeled.

FIG 7d **PRIOR ART**

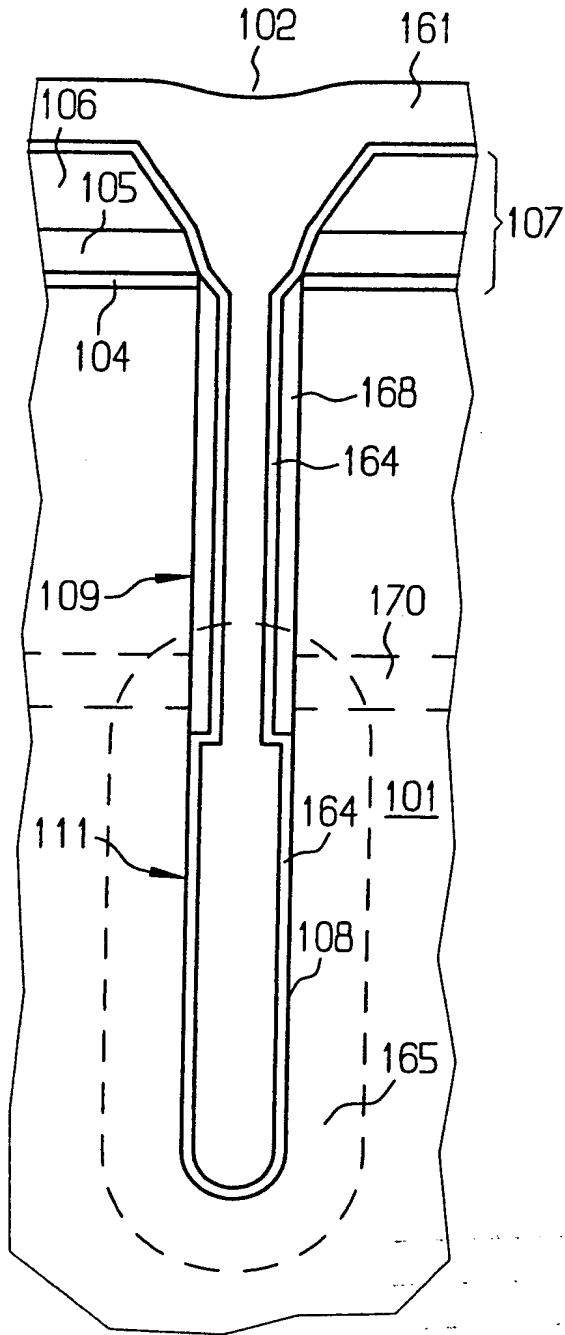


FIG 7e **PRIOR ART**

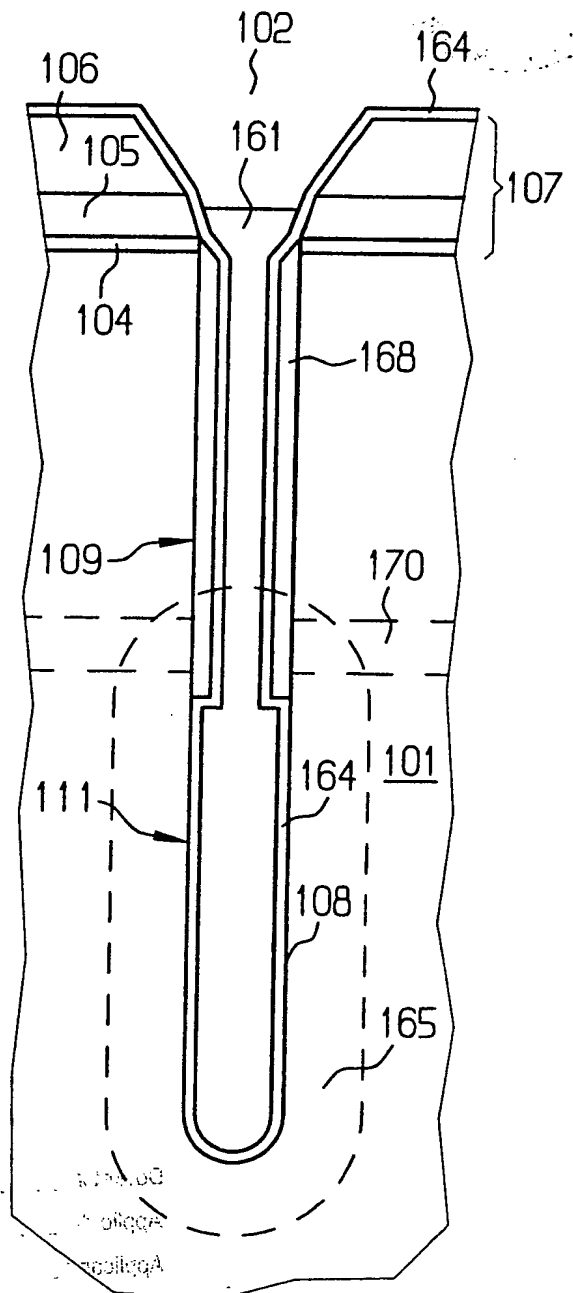


FIG 7f **PRIOR ART**

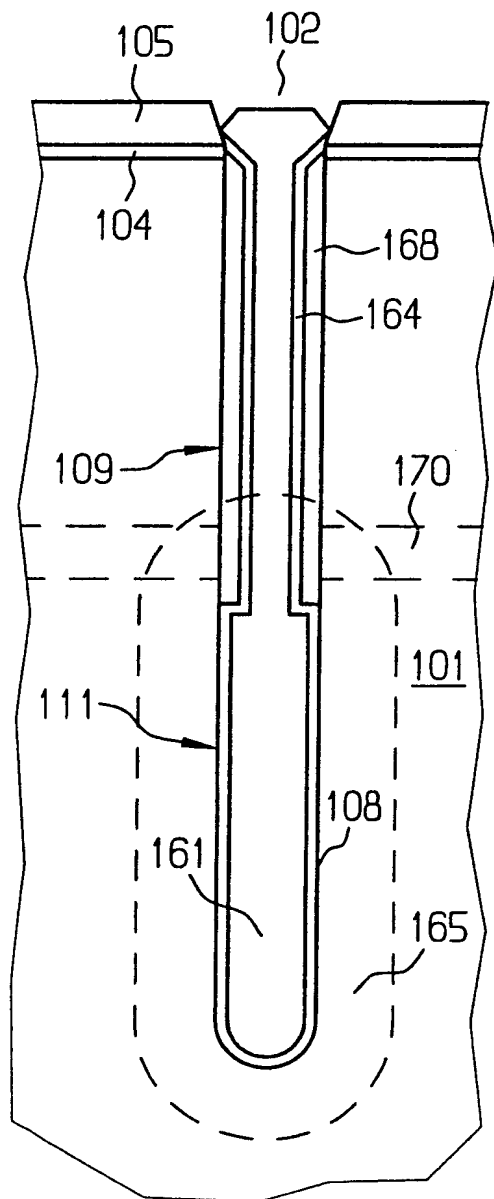


FIG 7g **PRIOR ART**

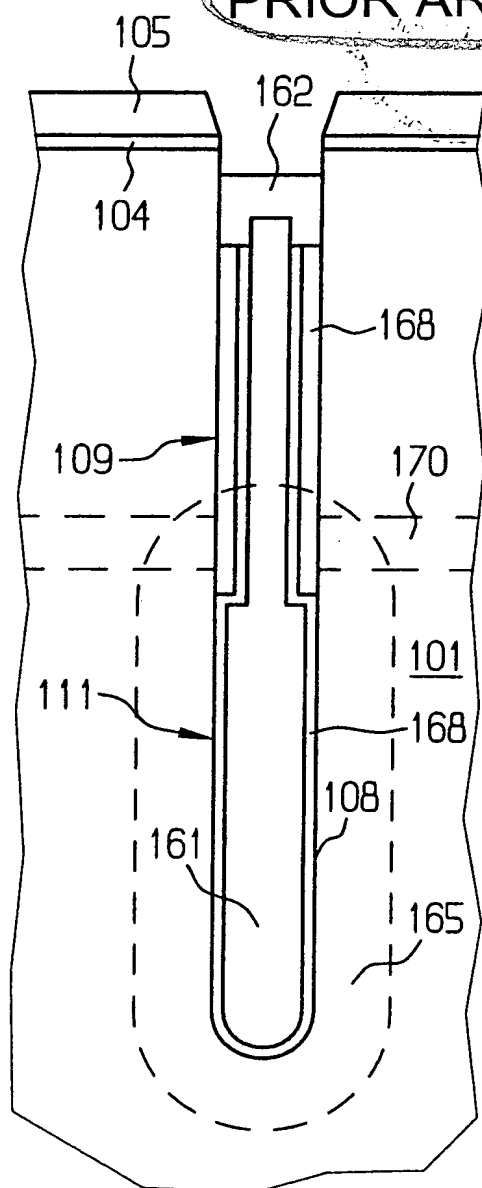


FIG. 7f and FIG. 7g are cross-sectional views of a device in a prior art configuration. The device includes a substrate 101, a top layer 105, and a central channel 102. The channel walls are labeled 104 and 168. A horizontal layer 109 is located within the channel. A dashed line 111 indicates a boundary. The bottom of the channel is labeled 161. The outer boundary of the device is labeled 101. Other labels include 164, 170, 108, and 165.

PRIOR ART



FIG 9 **PRIOR ART**

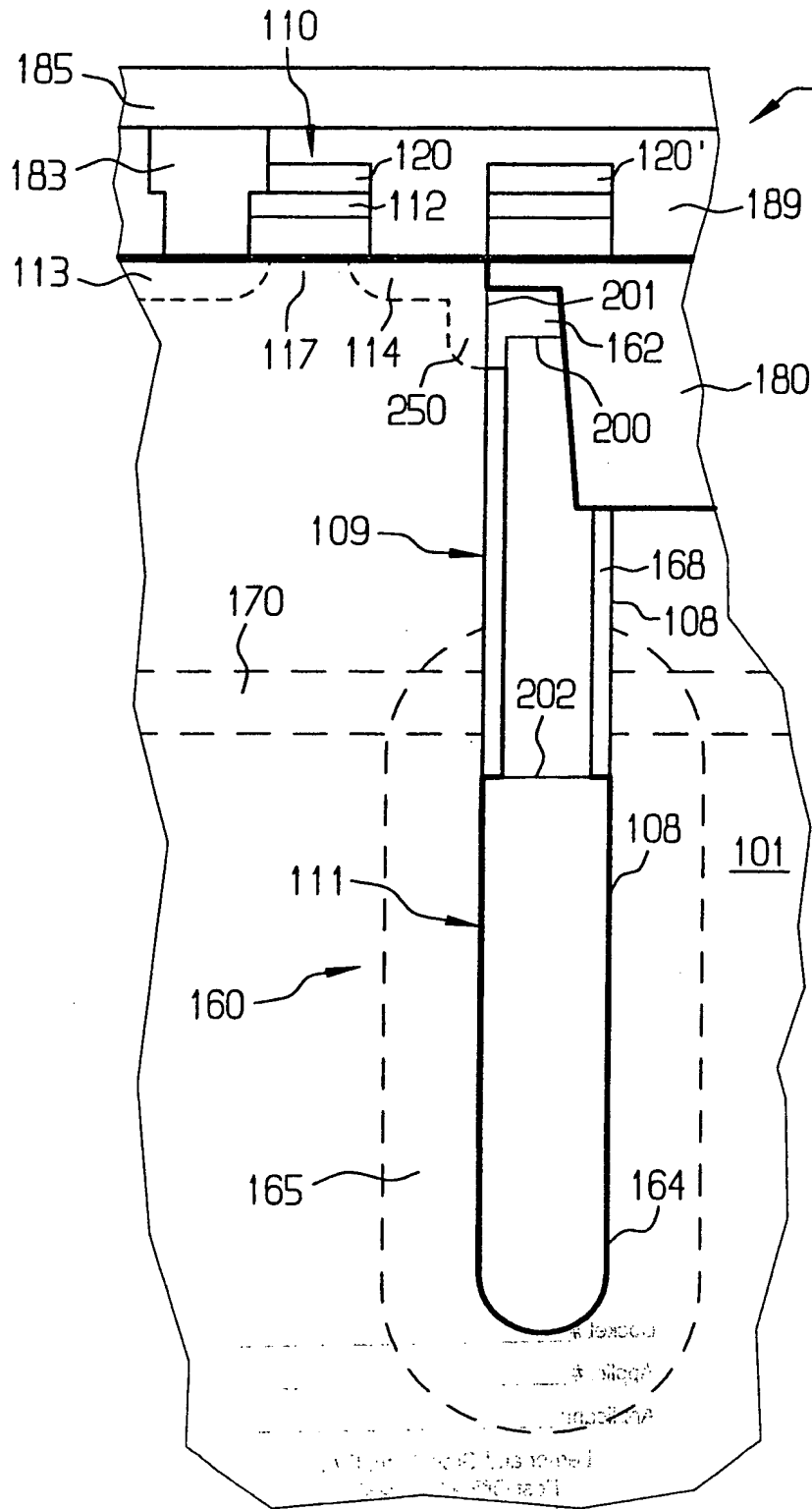


FIG 11a **PRIOR ART**

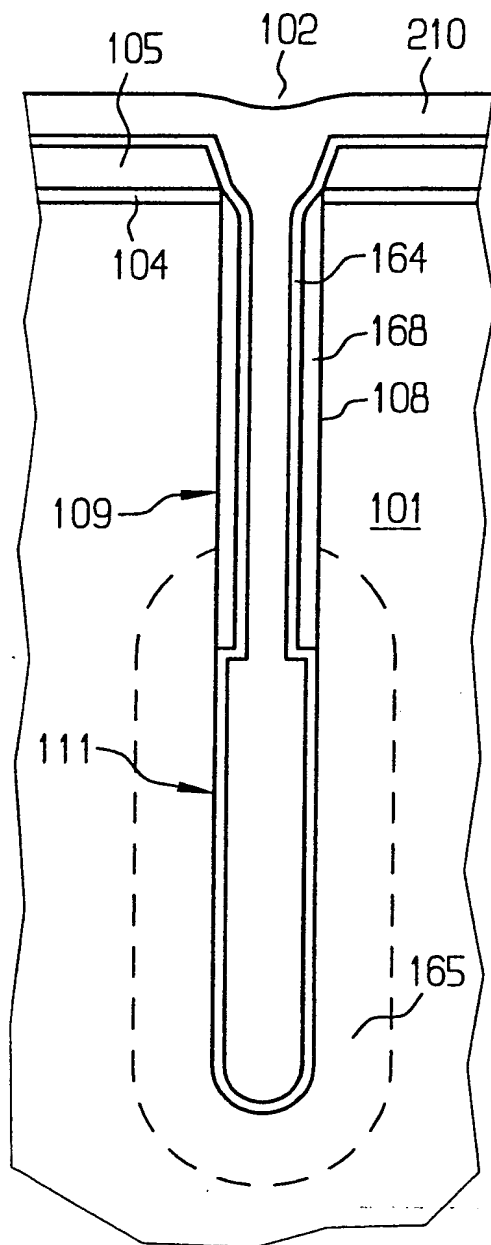
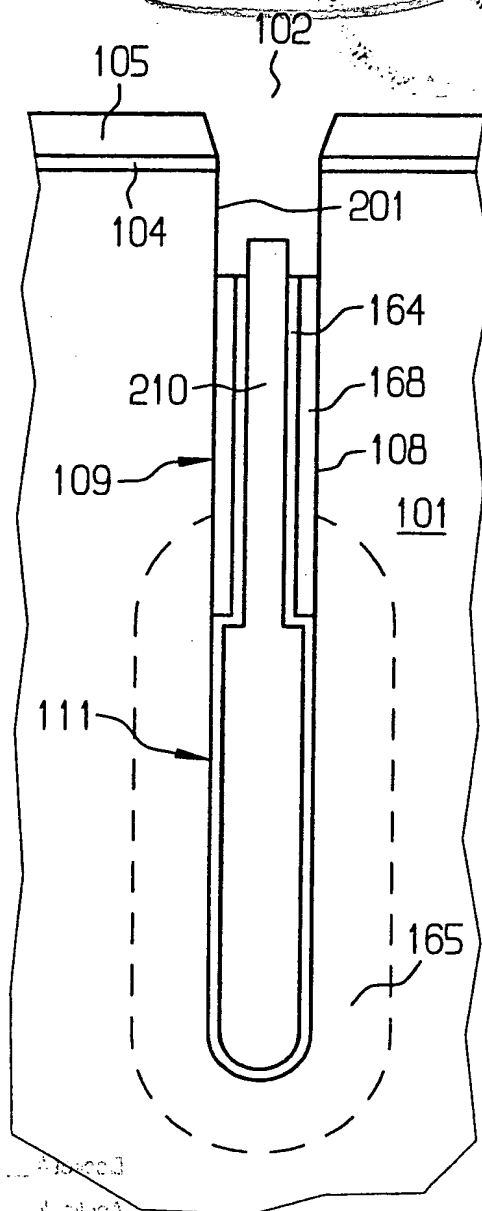


FIG 11b **PRIOR ART**



PRIOR ART



FIG 11c **PRIOR ART**

FIG 11d **PRIOR ART**

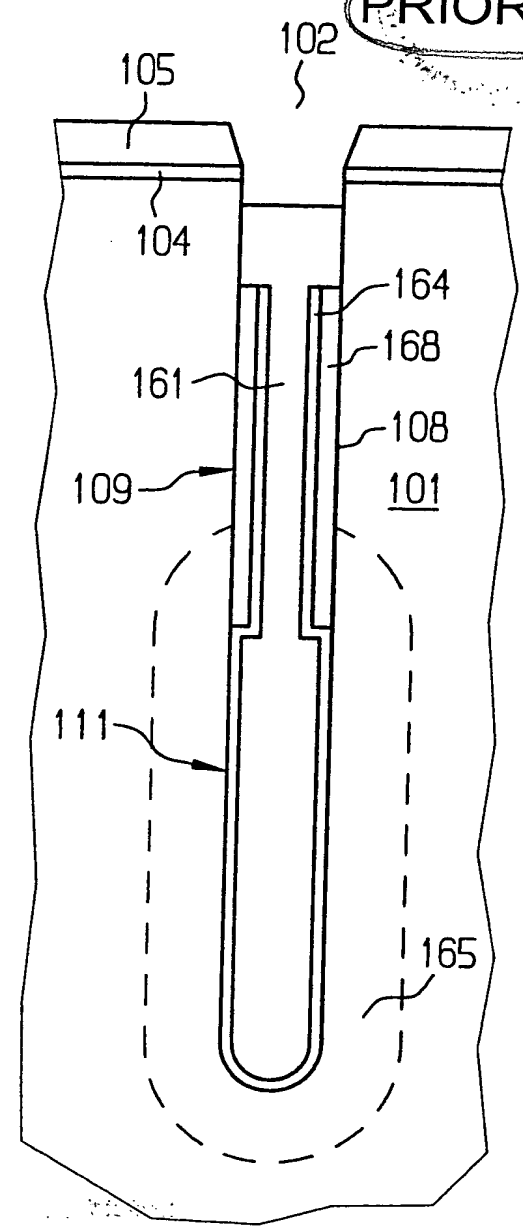
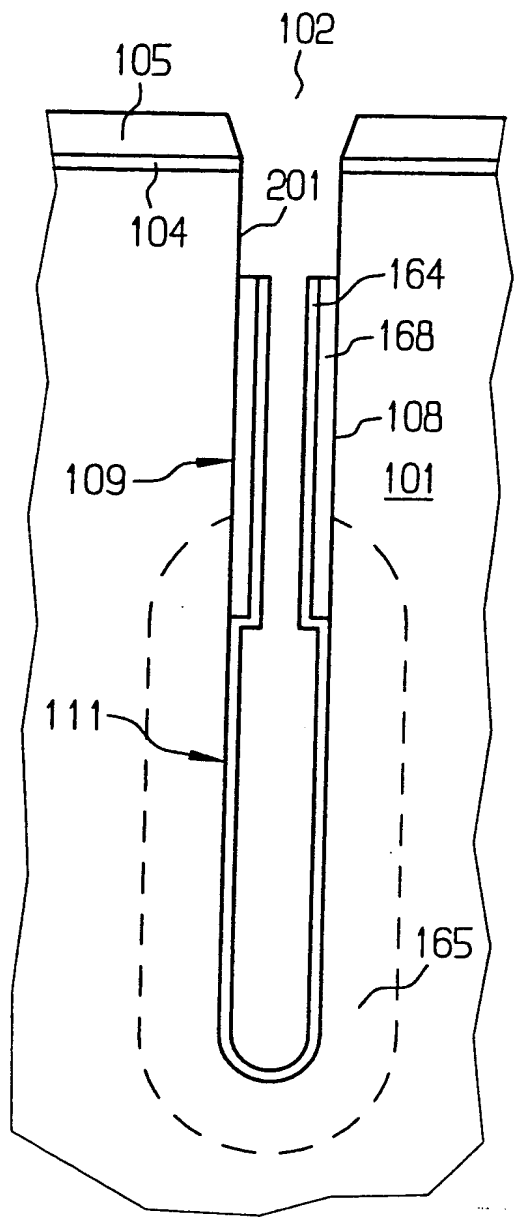


FIG. 11c and FIG. 11d are cross-sectional views of a device in a prior art. The device includes a substrate 101, a gate stack 102, a gate electrode 104, a gate insulator 105, a channel layer 108, a source/drain region 109, a source/drain contact 111, and a source/drain electrode 165. The device is a U-shaped device.

PRIOR ART

